Touching new markets

Capacitive touchscreens – game changing technology required to expand market reach. By **Alvin Wong**.

Touchscreen technology has been one of the cornerstones in the rapid advancement in user interfaces of both portable and static electronics equipment. The iPhone perhaps represents the biggest such success story, but there are many other sectors in which product functionality, ergonomics and aesthetics have benefited by incorporating touchscreens, rather than electromechanical switches, potentiometers and the like.

Resistive touchscreens have been widely adopted in mobile handsets, as well as other applications such as portable GPS and handheld gaming platforms. Despite some evolution in resistive touchscreen technology, the user 'experience' is still considered to be lacking both by product designers and, more importantly, by consumers. This deficiency was made clear when projected capacitive touchscreens arrived.

The technology enabler for the intuitive user interface, projected capacitive touchscreens have become the preferred technology for tablets and smartphones.

However, capacitive touchscreens are more expensive than resistive technology and there are significant technical challenges that need to be overcome in order to implement a new design successfully. With a limited apparent cost reduction path, an innovative change in direction is required to allow capacitive touchscreens to be considered seriously for more applications.

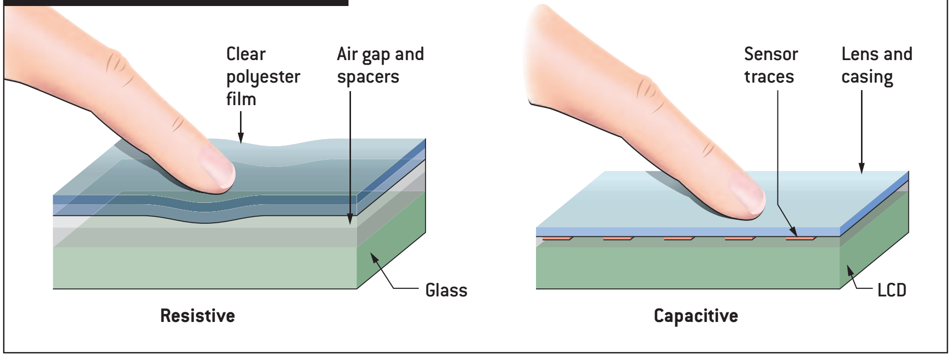
Touchscreen technologies other than capacitive and resistive exist. These include surface acoustic wave, infrared, optical image, bending wave and active digitisation. Some of these are appropriate for niche applications and where screen sizes are very large. Others have, to a large degree, fallen by the wayside due to the competitive benefits of either resistive or capacitive approaches.

The resistive touchscreen comprises a flexible hard coated outer membrane with a conductive inner layer separated from a similar conductive layer by insulating spacer 'dots', providing an acceptable – though not high – level of performance. Because physical contact between the two conductive layers is required, point pressure – often via a stylus – is needed. Aside from this, the primary disadvantages of this low cost approach are low transmissivity of light (in the region of 75 to 85%) due to the multiple layers and limited durability of the outer polyester film layer (approximately 100,000 to 1million touches). Despite these apparent drawbacks, resistive touchscreens have been used for many years by numerous leading phone and smartphone manufacturers.

Recent improvements in resistive touchscreens have focused around aesthetics, rather than function. These include a sleeker 'bezel less' design and a glossy, rather than 'filmy', appearance. However, these touchscreens still require physical pressure for a touch to be recognised: a less elegant interface.

An important plus point for resistive touchscreens comes in the supporting circuitry.

Fig 1: Incumbent touch technologies



With real estate at a premium inside mobile handsets, the potential to integrate previously discrete components is welcomed. In many of the latest handsets that use resistive touchscreens, it has been possible to integrate the screen controller into either the application processor, the main microcontroller or into the audio codec. This contrasts with capacitive touchscreen controllers, which typically require discrete components placed near the touchscreen to achieve optimal performance and reduce noise interference.

Meanwhile, projected capacitive touch technology is well proven. Responsiveness to direct touch, rather than point pressure, a transmissivity of at least 90% and greatly enhanced screen durability due to a rigid cover lens contributed to making projected capacitance touchscreens the technology of choice for Apple. But the primary enablers for the intuitive user interface experience are the light 'pressure less' touch recognition and multitouch capability. Smooth scrolling, light flicks to pan down menus and multitouch gestures to zoom in or out are easily acquired skills for the consumer that allow rapid navigation between the iPhone's functions.

Projected capacitive touchscreens traditionally consist of patterned conductive coatings (one X axis layer and one Y axis layer) aligned to produce a matrix structure. A third shield layer is often required to protect the touchscreen against the effects of the lcd or amoled display.

Despite the compelling user benefits, the adoption of capacitive solutions has been relatively conservative in other market segments and there are both technical and commercial reasons for this. Firstly, today's two or three layer capacitive touchscreens are between two and five times more expensive than their resistive equivalents; for many potential users, the cost premium is too high. Another factor is there are no off the shelf solutions, so there is a significant development curve to any new implementation. This is made more challenging because a finely tuned system solution is needed – a screen and a controller cannot be simply interfaced; rather, they need to be matched carefully. The touch controller chip is typically a complex device with an analogue front end designed to reject noise and built in proprietary sensing IP and complex, custom algorithms.

The final implementation issue with capacitive solutions concerns electrical robustness. To ensure noise emanating from the lcd does not impact performance, it is necessary to locate the touch controller as close as possible to the sensor; in most cases, this is on the flex tail close to the touchscreen.

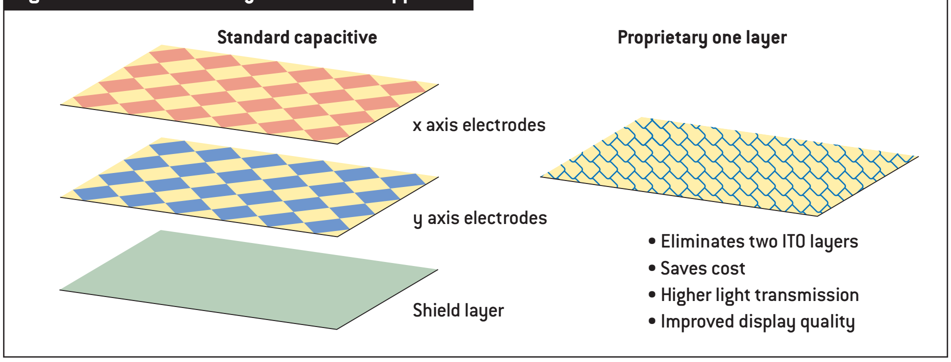
With traditional multilayer sensor construction, cost reduction occurs gradually with scaling and more suppliers, but not to the extent that would encourage accelerated adoption levels for existing capacitive touchscreen technology.

A true single layer, multitouch indium tin oxide (ITO) solution, such as that developed recently by IDT, simplifies sensor manufacturing and has the potential to offer significant cost savings. Existing approaches require up to three conductive ITO layers: X and Y electrode layers and a third shield layer. With a typical cost of around $1 per layer for screens of up to 5in, the potential benefit of a single layer approach is easy to see. In addition, fewer layers simplify manufacturing, improve yields and improve light transmission. This reduces backlighting and extends battery life.

The latest addition to the IDT PureTouch family uses a proprietary one layer ITO sensor pattern that incorporates the functionality of both X and Y sensor layers. This single layer multitouch design does not require additional mask steps to insulate sensor crossover points and bridge X and Y sensor matrix lines. Additionally, by incorporating all sensors into a single layer, the IDT solution eliminates the traditional problem of multitouch ghosting, which makes accurate X/Y data determination difficult when multiple fingers are placed in ambiguous locations. With many companies using host interpreted custom gestures to differentiate their solution, accurate X/Y data becomes critical.

Finally, the design and robustness of the touch controller ic is critical. In the case of IDT's LDS7000, the design of the analogue front end provides a high level of noise rejection performance that negates the need for a separate touchscreen shield layer. This combination of a cost effective, multitouch capable sensor and robust touch controller ic enables IDT to address this growing market in a novel way.

Fig 2: Benefits of a one layer multitouch approach



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